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(54) IRRIGATION DEVICE

(71) I, GIDEON GILEAD, 5, Nicaragua Street, Jerusalem, Israel, Israeli Nationality, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a trickle or drip irrigation device.

As is well known, drip or trickle irrigation is used wherever water is scarce and where, with conventional devices such as sprinklers and the like, the quantities of water are dispensed therefrom are not only superfluous but in many cases harmful to the plants to be irrigated.

According to the present invention, there is provided a drip or trickle irrigation device comprising an elongated hollow hose for conveying fluid through the interior thereof and formed of inner and outer coaxial tubular elements having confronting surfaces in contact with one another, at least one of said surfaces being formed with a helical groove to provide a helical fluid flow passage between said confronting surfaces; wherein a plurality of holes extends through the wall of said inner tubular element at axially spaced intervals along said hose, each of said holes placing the interior of said inner element in communication with said helical passage for fluid transmission thereto; and wherein a plurality of fluid discharge openings is provided in said outer tubular element, each discharge opening being wholly disposed an axial distance along said hose from a respective one of said holes and placing said helical passage in communication with the hose exterior.

An assembly of the inner and outer tubular elements provided with the holes and openings as indicated above, can be manufactured in endless lengths (e.g., from known plastics hoses, such as those used to enclose electrical conduits, which are commerically available at relatively low expense) and can be used as a water conduit, the water trickling from the discharge openings in the outer tubular element.

With such an irrigation device it is possible for the user, e.g., the gardener or agriculturist, to cut pieces at will and connect these cut pieces to water conduits of whatever kind, each cut piece then serving as a trickle-emitting member.

In another embodiment of the invention, the outer tubular element is constituted by a plurality of unconnected sections each overlying one of said holes and each providing or having a said discharge opening, the unconnected sections being spaced axially of the hose to expose to the hose exterior the intermediate regions of the inner tubular element.

By way of example, six embodiments of the invention will now be described with reference to the accompanying drawings in which each of Figures 1 to 6 is a schematic longitudinal cross-section of a respective one of said embodiments.

Turning to Figure 1, a commercially available plastics material tubular element 1 having a helically grooved outer surface is provided with a plurality of holes spaced apart at predetermined points along its length through the wall thereof. One of these holes is indicated by the numeral 2. The tubular element 1 is inserted with a tight fit into an outer smooth, cylindrical, plastics tubular element 3 which at certain intervals is provided with discharge openings or ports 4 through the wall thereof. The helical ridge defined by the helical groove has a maximum diameter substantially equal to the diameter of the bore of the outer tube element 3. If desired, the outer surface of the inner helically grooved tubular element 1 may have more than one helical groove.

Water is presumed to flow in the inner tubular element 1 in the direction of the arrow in Figure 1. Water will flow out from the hole 2 and continue to flow in a helical path around the inner tubular element 1 and within the outer tubular element 3 until it reaches an outlet or discharge opening 4 from which it will trickle or drip slowly. Thus the helical path which is formed between the inner and outer elements in effect lengthens the travel of the water to its discharge opening 4 and, due to the narrow path created by the helical groove on the inner element 1 and the resulting friction in

the so created narrow helical passage or conduit, pressure which might exist at the supply is lost or dissipated and the water trickles or drips from the discharge opening 4.

The embodiment shown in Figure 2 is similar to that of Figure 1, but here the inner tubular element 10 is grooveless and smooth while the outer tubular element 30 is helically grooved. Again, a helical passage or path is formed between the two elements of which the inner one 10 has an outer diameter substantially equal to the minimum inner diameter of the outer, grooved element 30. Again, an opening 2 leads from the interior of inner tubular element 10 into the helical passage or path and an outlet or discharge opening or port 4 from the latter leads to the hose exterior.

Figure 3 illustrates yet another embodiment of two coaxial and superimposed elements. Here both elements are helically grooved and the peak of the helical ridge formed at the exterior surface of the inner element 100 is in tight-fitting contact with the helical ridge formed at the interior surface of the outer element 300, preferably at the line of the smallest diameter thereof. Also here, a hole 2 is provided in the wall of element 100 leading from the interior thereof to the helical passage formed between the two elements 100 and 300, and an outlet or discharge opening or port 4 is provided in the wall of element 300 leading from the helical passage to the hose exterior. Thus in each of the above-described three embodiments, a narrow helical passage is formed, by means of which pressure under which the water might be fed to the line is dissipated.

It can easily be seen that the assembly so produced will serve as a water conduit and at the same time as a trickle emitting device. The water flows within the inner tubular element and enters the helical passage wherever holes have been provided in the inner tubular element, continues along the helical passage and exits through an outlet or discharge port or opening in the outer tubular element.

It can further be seen that any desired length of the assembly can be cut so that it would be possible to fit such pieces in an existing water conduit or connect them thereto.

Turning now to Figure 4, here the outer element does not extend along the whole length of the helically grooved inner element, but short sections 3′ of the outer tubular element are provided at spaced intervals. Each section 3′ overlies a hole 2′ in the inner element and has its ends spaced from the hole 2′. A substantially annular space 40 is formed between one end of each section 3′ and the inner element 1, this annular space constituting the discharge opening for the water flow. This water flow enters helical passage between the inner element 1 and each of the outer element sections 3′ from the hole 2′ associated with that section and placing that helical passage in communication with the feeding line or conduit constituted by the inner element 1. The water actually drips out from the openings or annular spaces indicated by the numeral 40. It should be observed that after passing from the interior of the inner element into the helical passage or path between the inner element and outer element sections, the water may flow in one direction only or in two directions (i.e., towards both ends of each of the sections 3′).

In another arrangement, the individual outer element sections that are axially spaced from one another can be slidably mounted on the inner element so that they may be used also to control the quantity of water emitted during a given time unit from the irrigation device. Such an arrangement is apparent from Fig. 5 which shows just one such section 3″ of greater axial length than the section 3′ of Figure 4. If it is assumed that water from the supply flows in the direction of the arrow shown in Figure 5 and the section 3″ of the outer grooveless element is in the position shown, water entering the helical path through the hole 2″ will flow the whole distance indicated by the letter *a* and will flow out through the discharge opening 4″. Thus it will have a long way to travel and its velocity and pressure will be greatly reduced. If it is assumed that in this arrangement the water emitted during the time unit of 10 minutes is one litre, this quantity can be increased by slidably shifting the outer section 3″ to reduce the distance *a* and therefore there is less loss of pressure whereby the quantity emitted in the same time unit of 10 minutes will be larger. It can easily be seen that by appropriately sliding the outer sections 3″ relative to the holes 2″ of the inner element 1, the quantity of the emitted irrigation water can be controlled. It will be understood that markings can be provided on the outside of the inner element 1 for co-operation with one radial end of the sections 3″ to indicate the relative position of the inner element and outer element sections and thus the quantity of water emitted during a time unit.

Another practical embodiment of a trickle emitting device is shown schematically in Figure 6. Here the outer element 3 is provided with discharge ports stoppered by plugs 5, 15, 25. Water enters the helical path or passage between the two elements 1 and 3 through the hole 2. Now by removing any one of the stoppers 5, 15, 25, the quantity of water discharged during a time unit can

be controlled. For example, after removal of stopper 25, the water travels a short length of the helical passage or path and the quantity emitted might be 40 liters per hour. If only stopper 15 is removed, the quantity might be 20 litres per hour; and with removal of stopper 5 only, the quantity might be 10 litres per hour.

It will be apparent that in each of the above-described embodiments, each discharge opening provided by the outer element (or outer element section) is of constant cross-section and is wholly disposed away from an adjacent hole in the inner element by a predetermined, or predeterminable, axial distance.

Certain variations of construction may be resorted to without departing from the scope of the invention as defined in the following Claims. For example, any one of the described combinations of grooved and ungrooved elements may be enclosed in an outer sheath, itself being a grooved or an ungrooved hose.

While in practice all hoses might be of circular cross-section, it would be within the scope of the invention to employ hoses of oval or any other suitable cross-section.

WHAT I CLAIM IS:—

1. A drip or trickle irrigation device comprising an elongated hollow hose for conveying fluid through the interior thereof and formed of inner and outer coaxial tubular elements having confronting surfaces in contact with one another, at least one of said surfaces being formed with a helical groove to provide a helical fluid flow passage between said confronting surfaces; wherein a plurality of holes extends through the wall of said inner tubular element at axially spaced intervals along said hose, each of said holes placing the interior of said inner element in communication with said helical passage for fluid transmission thereto and wherein a plurality of fluid discharge openings provided in said outer tubular element, each discharge opening being wholly disposed an axial distance along said hose from a respective one of said holes and placing said helical passage in communication with the hose exterior.

2. An irrigation device according to Claim 1, wherein said outer tubular element has an ungrooved inner surface and said inner tubular element is formed with said helical groove such that its outer surface defines a helical ridge of maximum diameter substantially equal to the inner diameter of said outer tubular element.

3. An irrigation device according to Claim 1, wherein said inner tubular element has an ungrooved outer surface and said outer tubular element is formed with said helical groove such that its inner surface defines a helical ridge of minimum diameter substantially equal to the outer diameter of said inner tubular element.

4. An irrigation device according to Claim 1, wherein each of said confronting surfaces is formed with a helical groove defining a helical ridge, the inner and outer tubular elements being disposed with the interior helical ridge of said outer tubular element in tight contact with the exterior helical ridge of said inner tubular element to define said helical fluid flow passage.

5. An irrgation device according to any preceding Claim, and further comprising a plurality of stoppers removably inserted in selected ones of said discharge openings to prevent fluid discharge therefrom.

6. An irrigation device according to any preceding Claim, wherein said outer tubular element is constituted by a plurality of unconnected sections each overlying one of said holes and each having one discharge opening, the unconnected sections being spaced axially along the inner tubular element to expose intermediate regions of the inner tubular element.

7. An irrigation device according to Claim 6, wherein the discharge opening in each section is constituted by the annular space between one end of the section and the outer surface of the inner element.

8. An irrigation device according to Claim 6 or Claim 7, wherein each of said unconnected sections of the outer tubular element is axially slidable along the outer surface of said inner tubular element to vary the axial distance between a hole and discharge opening and thus the flow rate of fluid discharge from the discharge opening.

9. An irrigation device according to any one of Claims 1 to 5, wherein the inner and outer elements are each continuous and coextensive with one another.

10. A drip or trickle irrigation device substantially as herein described with reference to any one of Figures 1 to 6 of the accompanying drawing.

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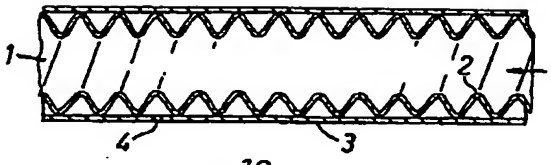

FIG.1

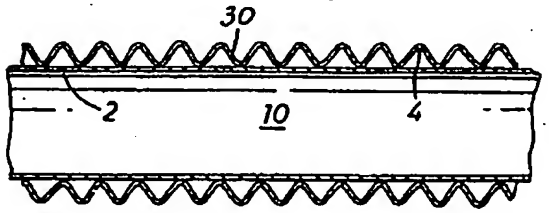

FIG.2

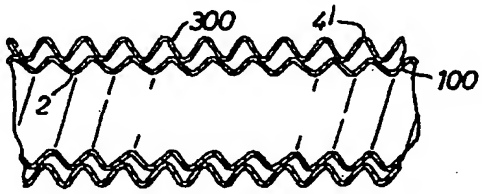

FIG.3

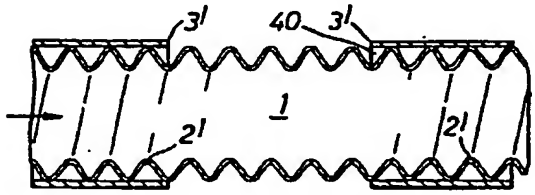

FIG.4

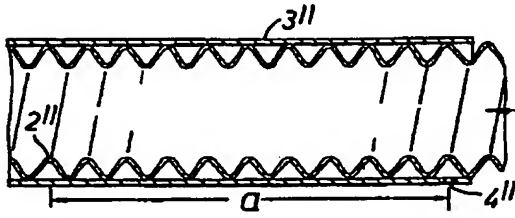

FIG.5

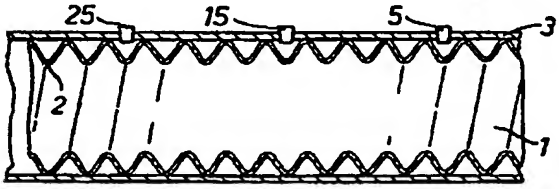

FIG.6